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THE AGRICULTURAL COLLEGE
EXTENSION BULLETIN

VOLUME 8 APRIL, 1913 No. 8

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CUTWORMS, WIREWORMS AND WHITE GRUBS

BY
JAMES S. HINE,
Assistant Professor of Entomology

They shook their trembling heads and gray
With pride and noiseless laughter;
When, well-a-day! They blew away,
And ne'er were heard of after.
—Helen Gray Cone.

PUBLISHED MONTHLY BY THE OHIO STATE UNIVERSITY
COLUMBUS

Entered as Second-Class Matter, November 17, 1905, at the Post Office at Columbus, Ohio, under Act of Congress, July 16, 1894.

DANDELION

There's a dandy little fellow,
  Who dresses all in yellow,
In yellow with an overcoat of green;
  With his hair all crisp and curly,
In the springtime bright and early
  Atripping o'er the meadow he is seen.
Through all the bright June weather,
  Like a jolly little tramp,
He wanders o'er the hillside, down the road;
  Around his yellow feather
The gypsy fireflies camp;
  His companions are the woodlark and the toad.

But at last this little fellow
  Doffs his dainty coat of yellow,
And very feebly totters o'er the green;
  For he very old is growing
And with hair all white and flowing,
  Anodding in the sunlight he is seen.
Oh, poor dandy, once so spandy,
  Golden dancer on the lea!
Older growing, white hair flowing,
  Poor little baldhead dandy
    Now is he!

—NELLIE M. GARABRANT,
Nature in Verses.

CUTWORMS, WIREWORMS AND WHITE GRUBS

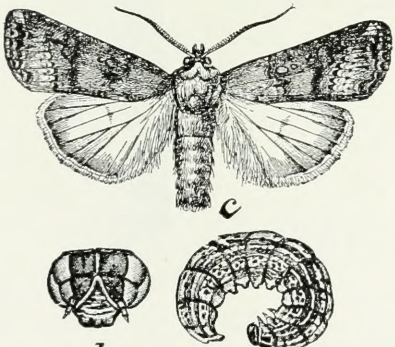
By James S. Hine

There are numerous insects that injure the roots and underground stems of plants. Many of these naturally work in meadows and pastures or where the ground is covered with sod. When such land is plowed and planted to grains or other crops injury results, often because the insects have no other food supply. Some of the best known and most injurious forms are included in the title of this brief account.

Often confusion exists in regard to insects which have similar habits, and the reason for treating these three topics in the same article is to bring out a comparison of habits and injuries to the end that a clearer conception of the work of each and all of them may be held generally.

Since many distinct insects are included under each group, the statements made are general and do not give the detail that is possible when dealing with a single species only.

CUTWORMS



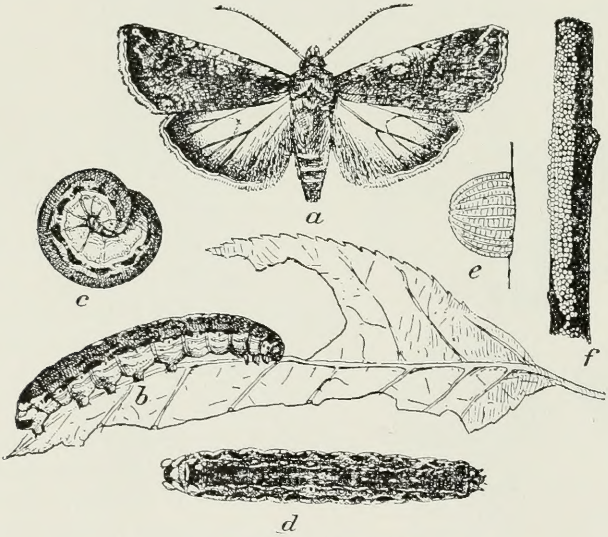
BEET CUTWORM
(a) Larva (b) Head of Larva.
(c) Adult—Somewhat enlarged.

This name is applied properly to a group of a dozen or more species of larvæ of night-flying moths. These worms or larvæ have the habit of cutting off various herbaceous plants at or near the surface of the ground during the night and dark days and then retiring into the ground, where they remain quiet while the sun shines. The adult moth usually lays her eggs in grass lands or in waste fields where there are plenty of weeds. Most species place their eggs in patches or in clusters on stems and leaves in late summer.

The young larvæ that hatch from these eggs feed on roots and stems near at hand and increase in size so that when frost comes they are a half-inch or more in length. They then seek protection among the turf or prepare themselves earthen cells beneath the surface, where they pass the winter in a quiescent stage. In spring, if the field where they are is allowed to remain in grass, plenty of food is at hand but, if the sod is turned under and the ground planted to corn or some other crop, their natural food supply is cut off and they are compelled to feed on the cultivated plants which are severely injured if the insects are abundant.

Whether in corn field, meadow or garden, if food is available, cutworms grow rapidly during the warm weather of spring and become full sized larvæ by early summer, when they enter the ground to change to pupae, or the next stage in their development. After a month or more in the ground, the last stage or moth appears with well developed wings, able to fly to some suitable place for location of the eggs.

The habit of the moth or adult is to place the eggs where the young that hatch from them will have access to a suitable food supply. So if it issues in the corn field or garden and finds these surroundings unfavorable it can and does fly to a meadow or pasture nearby; thus we have the explanation why crops planted on stubble grounds are not usually troubled with cutworms.



VARIEGATED CUTWORM

(a) Moth. (b) Normal form of larva, lateral view. (c) Same in curved position. (d) Dark form, dorsal view. (e) Egg from side. (f) Egg mass on twig. (U. S. Bureau of Entomology)

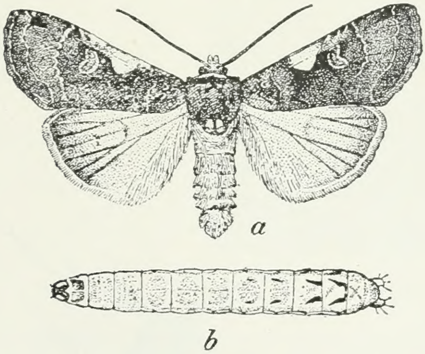
There is no real necessity for experiencing extensive losses from cut worms, for it is observed that corn or the crops started the first week in June are almost invariably free from injury. It often happens that the first planting of corn put into the ground by the middle of

May is entirely taken by cutworms, but a second planting made as soon as it is known the first is destroyed will come on, grow rapidly and, if the fall is not too early, produce a full corp.

Cut worms sometimes develop the climbing habit and become injurious to the foliage of trees. Cases are recorded where young peach trees under clean cultivation have been injured at night by these insects which were deprived of food on the ground and were compelled to climb or starve.

A remedy often given for cutworms is to plow infested fields in the late fall after the insects have selected winter quarters. By this treatment the larvæ are disturbed and many of them exposed to weather and natural enemies and not being able, on account of cold, to find another safe retreat are likely to be killed. This method has given satisfaction in a number of cases, and, from the standpoint of a remedy for the insects in question, appears to be practical.

Small garden spots may be freed, at least partially, from cutworms previous to setting valuable plants by placing at intervals of a few feet small piles of green clover that has been thoroughly sprayed while standing with an arsenical poison. Poisoned wheat bran moistened with sweetened water may be used for the same purpose and in the same way. These materials are attractive to the insects and should be in operation during the night time a couple of days before planting is done.

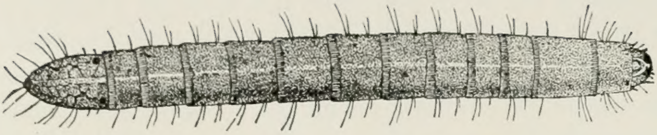


SPOTTED CUTWORM
(a) Moth (b) Larva somewhat enlarged.

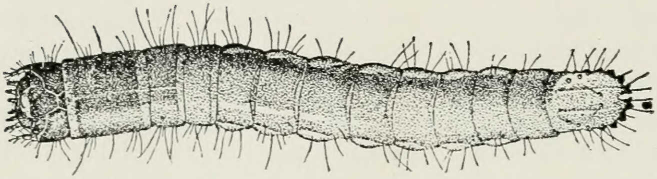
WIREWORMS

A prominent pest of field crops is a group of insects known as wireworms. They are the young of click-beetles or snapping-bugs, which are well known on account of their peculiar habits. They are brown, hard-bodied larvæ of nearly uniform size throughout, thus the well known common name applied to them is fully appropriate.

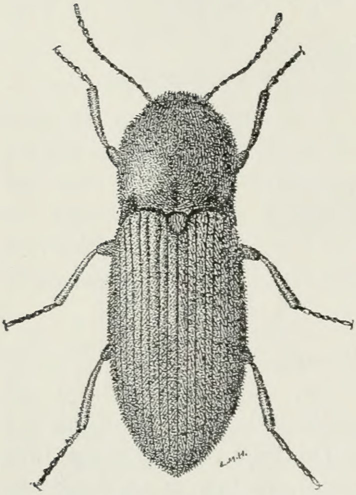
They bore into various seeds after planting or work on the roots of various plants, often causing serious injury. Eggs are laid on sod ground, and the larvæ which hatch from them normally work on the roots of grasses. If sod is plowed and the field planted to another crop, the natural food supply is cut off and the insects are forced to feed on other roots. Corn planted in hills is most noticeably injured



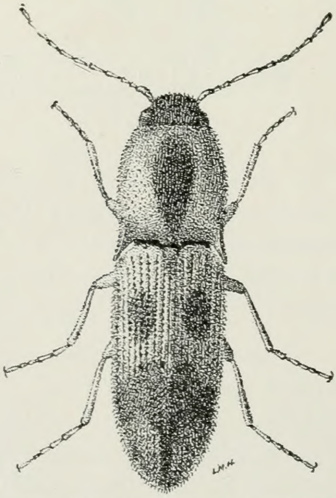
Common Wheat Wireworm; enlarged five diameters.



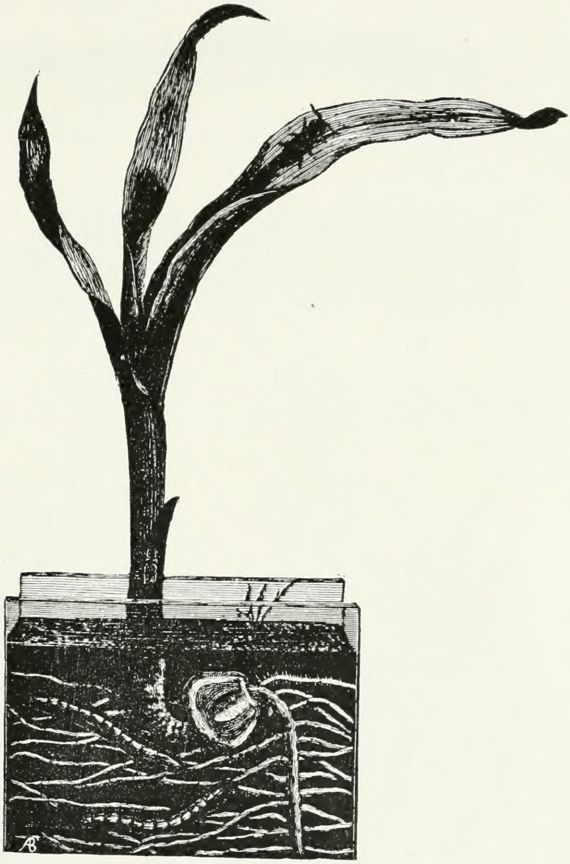
Larvae of Drasterius elegans (wireworm affecting wheat, corn and other plants) enlarged seven diameters.



Beetle of Common Wheat Wireworm; enlarged seven diameters.



Beetle of Drasterius Elegans; enlarged seven and a half diameters.

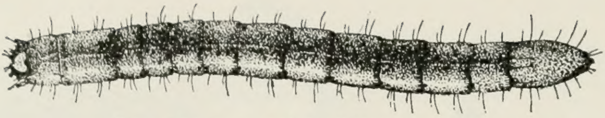


Drasterius elegans working on roots of corn plant.

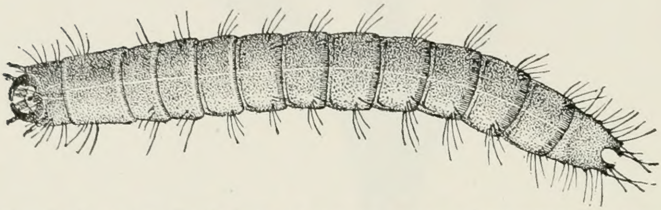
but various other crops suffer although the damage may not be quite so apparent.

Differing from cutworms, these insects pass from three to five years in the larvæ stage, consequently wireworms of different ages may be found working together in the same way, for some species at least produce adults every year. Larvæ of proper age change to pupae in midsummer in cells in the ground. Three or four weeks later the adult stage is reached but the beetles remain in the pupae cells until the following spring when they come forth and fly about the fields in search of a suitable place to lay their eggs.

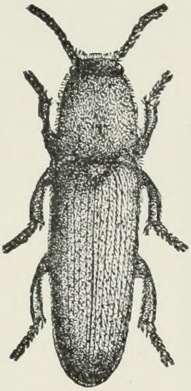
Since there are different ages of larvæ working together it is plain that there is no time when all specimens will be in the same stage at the same time. This makes control difficult since there is no practical



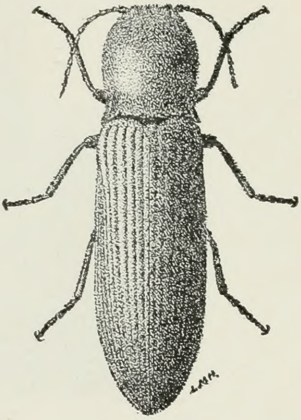
Corn wireworm; enlarged four diameters.



Larvae of Asaphes decolaratus (wireworm which affects wheat and other plants) enlarged three and three fourths diameters.



Beetle of Corn Wire worm; enlarged four and a half diameters.



Beetle of Asaphes decolaratus; enlarged four and a fifth diameters.

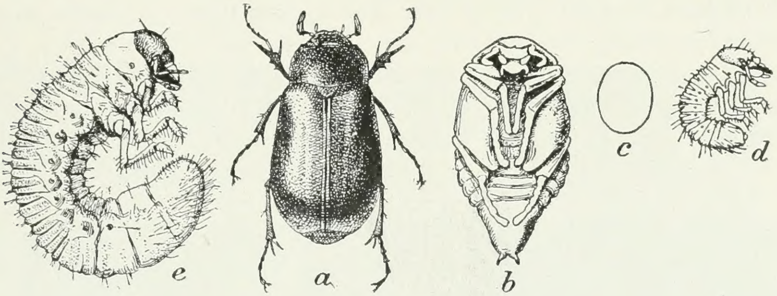
method known for killing them in the wireworm stage. After midsummer those that are to produce beetles the following spring are either larvæ or adults in a soft bodied condition in earthen cells a few inches below the surface. Slingerland found that early fall plowing and occasional harrowing thereafter broke up these earthen cells and exposed the insects which on account of natural enemies and frying out by the sun were killed in large numbers.

Wireworms appear to produce most noticeable injury on wet and sour land. Careful under-draining appears to improve conditions. It may not be possible to prove that drainage has any direct effect on the insects, but surely fully drained, fertile soil, well cultivated, makes it possible for the crop to grow so rapidly that insect injury is overcome to a greater or less extent.

WHITE GRUBS

There are several species of so-called May beetles in almost any given locality. The larvæ of these are the very common white grubs which are so injurious to a variety of cultivated plants.

The beetles or adults cut off the leaves of trees in spring and summer and do considerable injury in this way or by eating and tearing the foliage. Several species of trees are attacked, especially poplar, willow, ash and maple. They usually hide in soil during the day, fly to the trees at dusk and return to a hiding place before daybreak. Sometimes they remain quiet, clinging to foliage during the day.



MAY BEETLE
(a) Beetle (b) Pupa (c) Egg (d) Newly hatched larva (e) Full grown larva or white grub.

The eggs are often placed in sod ground or they may be laid in cornfields and gardens. The grubs hatch out about the middle of July and begin feeding on roots, grow slowly, and require two or more years to become full size. Larvæ of proper size and age change to pupae in midsummer and the adult stage is reached by September, but the beetles remain in the earthen cells made by the larvæ, three or more inches below the surface, until the following spring. Thus it is seen that the life cycle is much like that of the wireworm. Larvæ of different ages are present in the soil at any time during the year, consequently injury caused by them is continuous.

Plowing and cultivating the ground in early fall is destructive to the soft pupae and beetles by breaking their earthen cells and exposing them to various natural enemies.

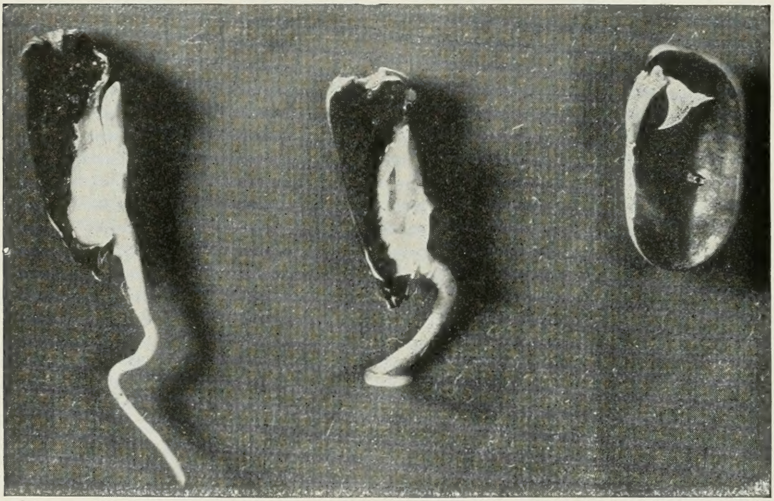
Dr. Forbes has made many observations on these insects in Illinois. He has reported fields of corn severely injured by the grubs. One count showed an average of 34.6 grubs for each hill of corn. Ten acres of corn field in which this count was made was used as a run for 108 pigs from September 23 to October 13, when another estimate yielded only 4.8 grubs per hill, or a decrease of 86 per cent.

The beetles are often trapped by hanging a bright light over a tub containing water with a surface film of coal oil. Such a trap may be placed near trees infested by the insects and good results obtained.

GERMINATION OF GARDEN AND FIELD SEEDS

By Vernon H. Davis,
Assistant Professor of Horticulture

On my table are some ordinary pebbles and some beans. They do not differ very much in size, shape, or color. One shows as many signs of life as the other, yet in a few weeks these beans may be living, growing things, full of life with all its mysteries, while the pebbles will not have changed at all or only slightly and these, or similar ones, may be furnishing the food that the beans are building into stem and leaves, flowers, and seeds. Every year, this miracle of nature is repeated many times, yet we do not understand fully just why and how these wonderful changes take place. We know nothing of life except as it is manifested through the bodies of plants and animals.

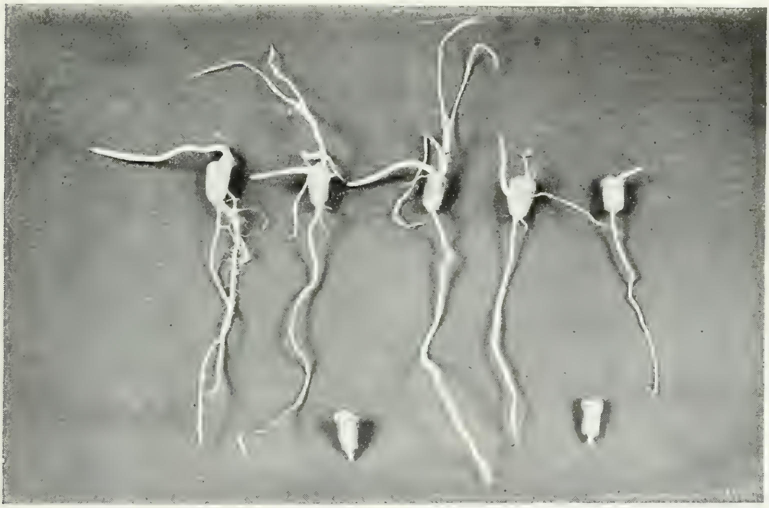


Corn *Bean*

Grains of corn and beans beginning germination, split to show part of embryo plant.

With a pocket knife, cut open the bean the long way of the seed. It will be found to consist of two distinct halves—cotyledons or seed leaves we call them. On one of these halves will be seen a very small white body, round and short, with two diverging parts on one end, looking very much like the tail of a fish. Look at these parts closely; they will be easily recognized as tiny leaves. Now with the point of a needle or pin, carefully separate these leaves and a little white projection will be seen between them. We have suprised Nature and discovered one of her secrets. Here, carefully tucked away in its cover and sound asleep, we have really found a very little plant—an embryo plant, we call it because, so far, all its growth and development have been as a part of the parent plant from which the seed came. When the warm sun and showers of spring wake it, these two thick halves of the bean will become the first leaves seen above the ground, thick and clumsy, which soon shrivel away. In the mean time, the short, round white body will have grown down into the soil and formed roots.

The tiny leaves that so much resemble the tail of a fish will develop into the first true leaves of the plant and the little white projection between them will start its growth into the stem with branches, leaves, flowers, and finally new seeds.



Corn germinating. Notice the root hairs, visible on some of the roots.

Lay on the table a corn grain with the furrowed side up and with a knife split it the long way as nearly in the center as possible. Just underneath the seed coat in the furrow and near the point of the grain will be found a small, whitish body. The knife will have cut it in two almost in the middle. It is the cotyledon (there is only one in the corn) and makes up perhaps one-third or less of the bulk of the entire grain. Examine it closely and on the upper side just beneath the covering there may be seen two small projections, one directed toward the point of the grain and the other toward the flat end of the grain. The former one will develop the roots, while the latter one will develop into the stalk.*

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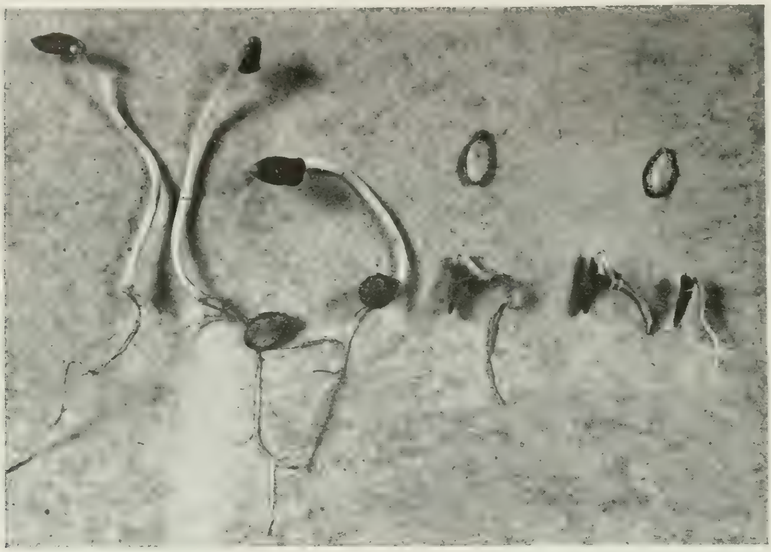
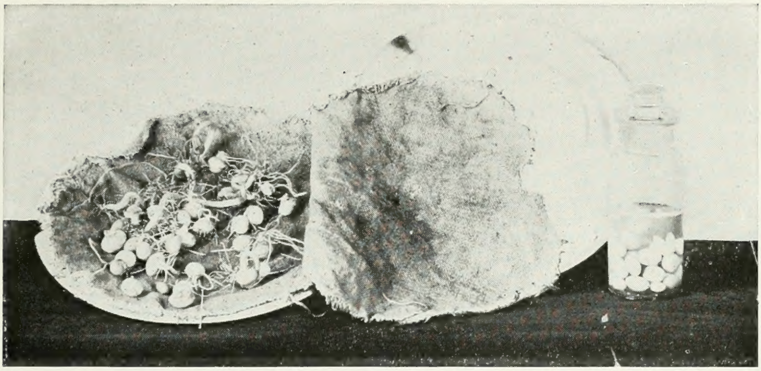
*While these parts of the seed may be seen with the naked eye in dry seeds, soaking the seeds for twenty-four hours before using will be very helpful.

It will be seen that the corn grain differs from the bean in that it has one cotyledon or seed leaf instead of two. Again it will be seen that in the corn, unlike the bean and the other seeds of itsclass, the little embryo plant does not make up the whole seed. The remaining part consists of starch, oil, and sometimes sugar, which serves as food for the little plant while it is developing its own roots and getting its leaves to the sunlight.



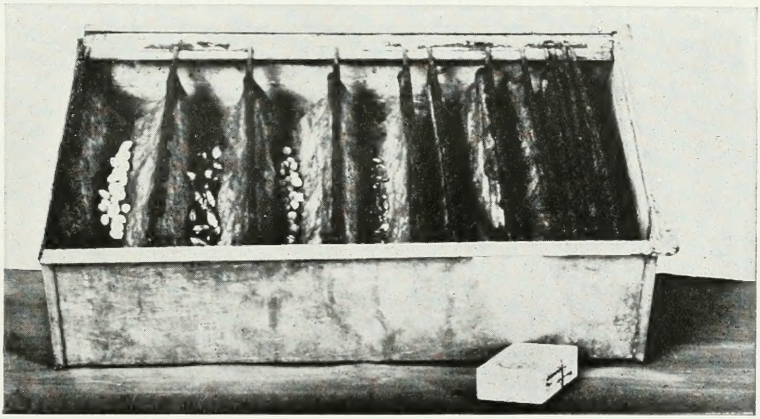
Pumpkin seeds germinating. Notice how the hook on the hypocotyl has caught one side of the seed case and is pulling it off the cotyledons.

In the bean, pea, pumpkin, and similar seeds, this food supply instead of being stored by itself as in the corn grain, is contained within the embryo plant and mainly in the thick cotyledons. It is the plant food in the cotyledons that makes them thick and fleshy. When this food supply is entirely separate from the embryo as in the corn, wheat, rye, buckwheat, and many other seeds, it is called endosperm. It is this stored food supply that makes seeds so valuable as food for man and farm animals. We simply appropriate for our own use what Nature has intended for the little plant. The necessity for this stored food will be seen when we remember that plants cannot use the crude material that comes from the soil and air, except in the presence of sunlight and the green coloring matter in the leaves and stems. Therefore, it would not be possible for the new plant to develop its own roots and get its stem up through the dark soil to the sunlight above without this supply of food ready at hand and ready to use just as soon as growth starts.



Home made seed tester containing sprouting beans. At the right a bottle containing beans covered with water. These failed to germinate because they could not get sufficient air.

Place these beans and grains of corn between the moist cloths of a seed tester, such as is shown at the top of this page and place in a warm room. In a short time, the seeds will be seen to have changed greatly. There will be a great increase in size and, in a part of the seeds at least, the seed case will be burst by this tiny round white shoot that we have already seen in both the corn and bean. This shoot always grows downward, no difference what the position of the seed may be, and from it the roots develop—hypocotyl, we call it because it is always under the cotyledons. The seeds have sprouted, that is, they have taken the first visible signs toward developing into a new plant. Germination is said to be completed when the young plant is able to get its food from the soil and air independent of the seed.



Geneva Seed Tester.

If these seeds had been kept perfectly dry, they would never have sprouted, however warm the air might have been around them but, as soon as they were placed where they could absorb water and at the same time be exposed to the air and a suitable temperature, they began to sprout readily. This shows that a certain amount of moisture must be absorbed by the seeds before germination can begin. Most seeds will absorb water at ordinary temperatures very rapidly and in very large quantities. Both the rapidity of absorption and the amount absorbed varies greatly with different seeds and with varying conditions.

Had the tester been placed in a refrigerator instead of a warm room, the seeds would not have germinated. Thus we see that a certain degree of warmth is also necessary to germination. The best temperature for germination varies greatly with the different seeds. The lowest temperature at which the corn and bean will germinate at all is about forty-five degrees F. The highest temperature is about one hundred and twenty degrees while the best temperature is from eighty to ninety degrees. Wheat and peas will germinate slowly at thirty-two degrees and at as high as one hundred degrees but a temperature of seventy-five to eighty degrees will be best. These temperatures refer to the soil in which the seeds are planted and not to the air.

The cut at top of page 13 shows sprouting beans in a home-made seed tester and also a bottle in which are some beans covered with water. The seeds were placed in each at the same time and they stood side by side in the same room. Not a single seed in the bottle shows any sign of sprouting and the odor indicates that decay has begun. On the other hand, many of the seeds in the tester have sprouted and there is no indication of decay. The difference could not have been due to temperature or moisture for both lots had plenty of each. The water in the bottle did keep the air away from the seeds, however, while it had free access to those in the tester. This is probably the reason why seeds planted in wet soils and seeds planted very deeply fail to grow. A few seeds such as those of the rice and some other water plants will sprout and grow under water but the seeds of most plants must be surrounded by a moist medium only, through which the air will freely circulate.

It is evident that seeds require three conditions before they will germinate, viz., a proper amount of moisture, a proper temperature, and a proper amount of free oxygen usually secured from the air but sometimes secured by some seeds in sufficient amount from water.

The more quickly seeds germinate after they are planted, usually the better will be the results. As seeds lie in the ground, they are exposed to many dangers. Squirrels, mice, birds, insects, and rot all prey upon them and, as the period during which they remain in the soil is shortened, so is the period during which these enemies may feed upon them. Again, those seeds that germinate quickest always give the strongest and most vigorous plants. Conditions unfavorable for the germination of the seeds of cultivated plants may be just right for the germination of weed seeds and by the time our tardy cultivated plants reach the surface, they are crowded and smothered by weeds. Everything possible should be done to get both the soil and the seed into a condition where prompt germination will take place.

In the hurry to get the farm work done, seeds are often planted before the ground is warm enough and dry enough to make quick germination possible. Nothing will be gained and often seed and labor will be lost by planting before the temperature of the soil during the warmer part of the day approaches the temperature at which experience has shown us the seeds germinate best.

There is a general tendency to plant seeds too deep. No definite rule respecting depth of planting can be given. It must vary with the seed, the soil, moisture, etc. Since the little plant must force its way up through the soil that covers it, the less the depth, other things being equal, the less the energy and time required for the plant to reach the surface.

The general rule may be given that SEEDS SHOULD NEVER BE PLANTED DEEPER THAN IS NECESSARY TO SECURE THE PROPER AMOUNT OF WATER. Very small seeds like the celery, lettuce, tobacco, petunia, etc., should be planted VERY shallow or the young plant will never be able to reach the surface. These seeds are frequently sown and pressed down into the soil without any covering at all, the surface of the soil being kept moist by frequent sprinkling.

Compare the figures on pages 11 and 12 and note the difference in the devolopment of the young plant. In the pumpkin, the large cotyledons or seed leaves are pulled up through the soil with considerable difficulty. In the corn, the cotyledon with the endosperm remains within the seed coat and just at the point that the grain was planted. The long white shoot easily finds its way up through the soil. Seeds that lift their cotyledons up through the soil must not be planted deeply. While the pea, corn, and wheat will find their way up through several inches of loose soil in many cases, the cotyledons of the large beans may fail to get through an inch of heavy clay soil.

The time required for germination varies greatly with different seeds. Those of the lettuce and radish will often sprout within twenty-four hours if all the conditions are favorable, while the seeds of some plants cannot be made to germinate the same year they are produced.

Individuals seeds of the same sample may vary several days in the time required for sprouting. Seeds may fail to germinate for a variety of reasons, even when all the conditions are favorable. They may be too old. While many seeds retain their vitality for several years, it is generally true that under the most favorable conditions, the number of seeds germinating in a given sample gradually become less and less every year until their vitality is entirely lost. Some seeds, as the parsnip, will rarely ever germinate after the second year. Seeds are sometimes allowed to become too dry. They are sometimes frozen before they become dry. Seeds are rarely ever injured by drying in the air but if dried by artificial heat, their vitality is often impaired. Most seeds will stand any ordinary temperature if they are thoroughly air-dried, but, if not, even slight freezing may be injurious. Insects and disease may have injured the seeds, either before or after harvesting.

Such defects are not always visible. Therefore, it is highly important that all seeds should be tested before planting. Great loss of time and labor as well as crop loss by a poor stand of plants will frequently be prevented. It is not necessary, nor is it always desirable to plant seeds in the soil in order to test them. The cut at the top of page 13 shows a useful and very satisfactory tester for home use. It consists of two ordinary dinner plates and two circular pieces of flannel cloth. The cloths are dipped in water and wrung out until they are moderately wet, and spread on one of the plates, with the seeds placed between them. The other plate is then turned upside down on the first one in order to prevent evaporation, and the test is started. It may be necessary to moisten the cloths once or twice before the test is completed. This should be done by sprinkling, care being taken to use only as much water as the cloths will readily take up. One hundred seeds should be used in every test. This number will be sufficient to show the per cent. of vitality and the per cent. can easily be figured. The seeds should be frequently examined, those sprouted removed and a careful count kept of them. For most farm and garden seeds, the test should be run ten days, but with the grasses, it should be continued at least two weeks. If seventy-five seeds out of a hundred sprout, we say the sample is seventy-five per cent. viable. The temperature of the ordinary living room will be about right for most seeds.

A. B. GRAHAM,
Ohio State University,
Columbus, Ohio:

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